Space Weather Technical Forecast

Issued on Friday, 15 July 2022 at 13:01 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1-R2 Likely. Active electron fluence Expected into new week.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate in the past 24 hours, with X-ray activity at GOES16 comfortably in C-class, and with a peak flare of M2.8 observed from sunspot region AR3058 at 14/2148UTC. This sunspot was one of up to six on the solar disc, with all bar a new unnumbered region in the far east showing as Zurich E-groups.

Regions AR3053, 3055 and 3057 all showed decreases in area in the period, with all exhibiting decaying in their trailing groups especially. By contrast, AR3056 and AR3058 showed proliferation and areal growth - the former in its trailers and the latter in its leaders. The new region in the far east currently presents as an Hsx/Alpha, however the plage extends some way to the east and this may yet reveal further detail as the viewing angle improves.

There are currently numerous large filaments on the visible disc in the solar 'tropics', some with spans in excess of 20 degrees, and all of which are being monitored.

Current coronagraphs show ejecta heading southeast from a 14/1500UTC prominence eruption; also eastwards from the aforementioned M-class flare. Both of these events have been modelled and are not expected to affect Earth. A more central possible disappearing filament was observed from the northwest around 14/2300UTC, as well as a concurrent disappearing filament centrally in the southern solar hemisphere. Finally, an eastern hemisphere event was observed at 15/0730UTC from near AR3058. These later events have yet to show on coronagraphs, should any ICME have resulted. At the time of writing therefore, no Coronal Mass Ejections (CMEs) with Earth-bound components were in evidence.

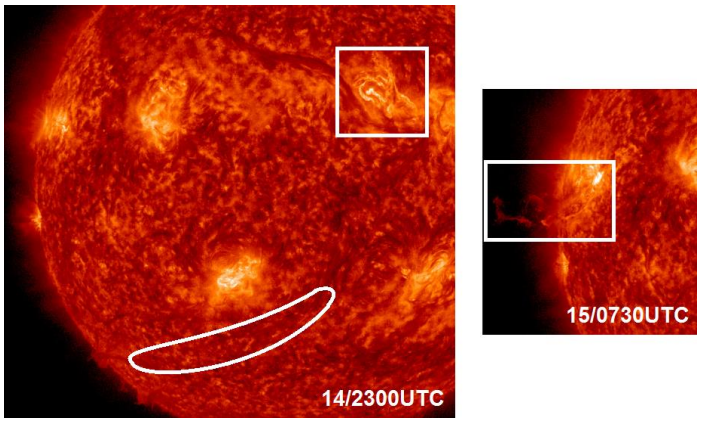

Figure 1: AIA304 imagery of events of note on the disc in the past 24 hours. None of the above events clearly manifests on coronagraphs at the time of writing, however these are being watched for.

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Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has been elevated over the past 24 hours, likely the result of connection to the fast wind of coronal hole 99.

The solar wind speed was elevated throughout, with a range of between 535km/s to 585, with a roughly level trend after an initial slight increase. The solar wind density was slightly elevated over the same period, on a flat trend in low double figures ppcc, while the IMF showed a slight decline from an early high of 9nT. The north-south component of the field varied between +7 and -5nT, but was mainly anti-aligned with Earth's field, especially between 14/1400UTC and 15/0400UTC. the phi angle was positive (away from the sun) throughout.

Despite the elevated speed and period of Bz anti-alignment, the net result of the above solar wind measures was nevertheless provisionally mostly Quiet, with Kp peaking at 3- in the 03-06UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, was at Background levels.

The high energy electron flux (greater than 2 MeV) was predominantly Moderate, peaking at 283pfu at 14/1830 UTC. The corresponding 24-hour integrated electron fluence remained well below the Active (1e8 integrated pfu) threshold, but with a slight rising trend. The observed fluence at 15/0001UTC was 6.69e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is Likely to be Moderate, with a daily Slight Chance of X-class flares. One of the current large sunspots should leave the Earth-facing side into the new UTC working week, resulting in a slight dip in flare risk on day four, Monday 18 July. Arriving bright flux over the eastern limb may compensate for any loss, however.

Solar Wind / Geomagnetic Activity: No CMEs feature in the current forecast.

The only coronal hole fast wind expected in the period is that from the current CH99, with this due to wane in earnest over the coming UTC weekend to leave a slow regime by the new week. There remains a Chance of isolated Active intervals on day one, with more reliably Quiet conditions being restored by the new week.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at Background levels, but with a daily Slight Chance of S1 or greater due to the presence of relatively large sunspot regions in the western solar hemisphere.

The high energy electron flux (greater than 2 MeV) is expected to increase over the coming days, with diurnal maxima exceeding the High (1e3 pfu) threshold. Fluence levels are also expected to increase, being Expected to exceed the Active (1e8 integrated pfu) threshold on day four, Monday 18 July.

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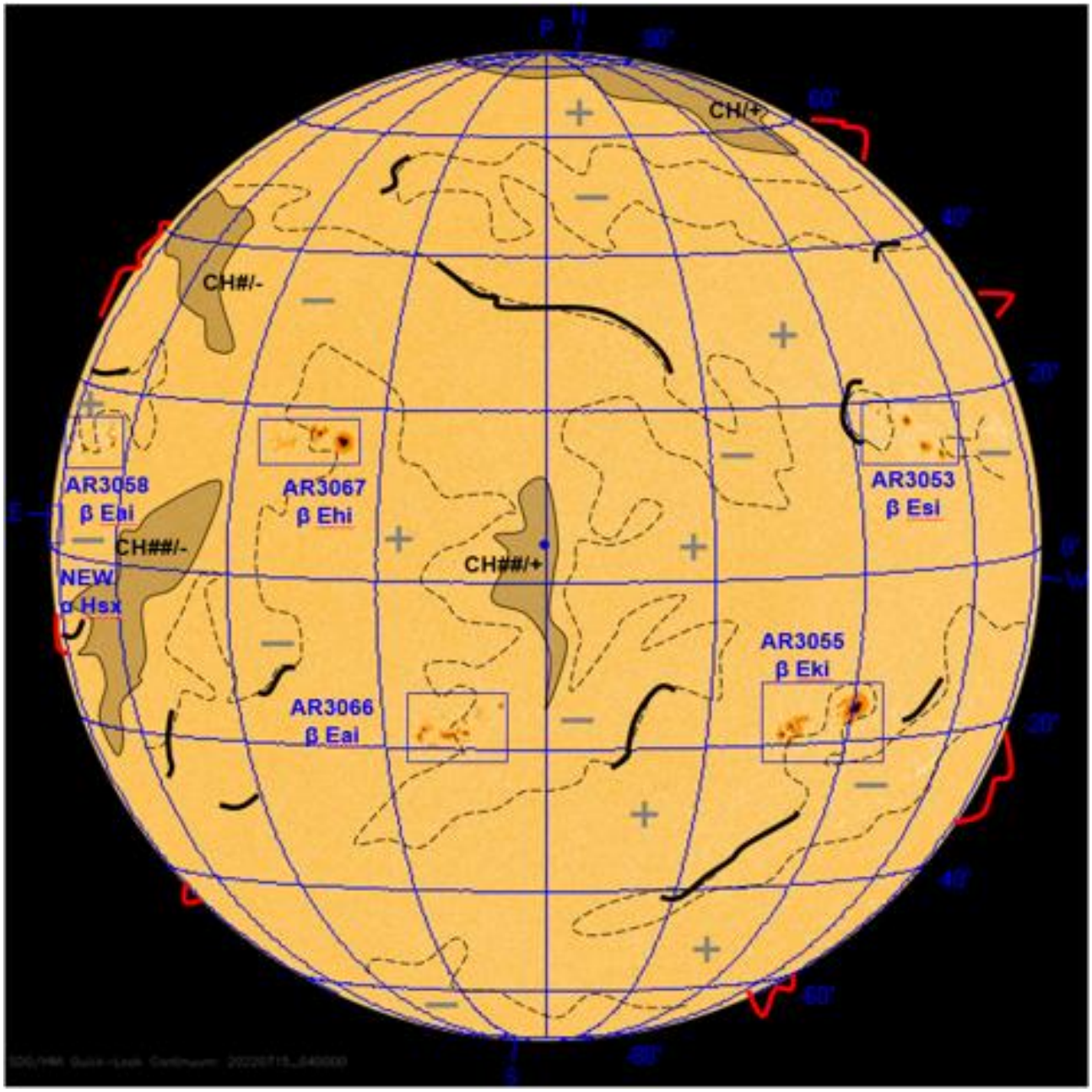
Figure 2. Solar Analysis Valid 15/0400UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in this forecast period, however there have been events in the past 24 hours that may have yet to manifest on coronagraphs.

Solar winds are expected to remain elevated on day one (Friday 15 July) due to the HSS originating from CH99/+. this feature has now long-peaked and the risk of G1 is now felt to have reduced compared with earlier guidance, although isolated Active intervals are perhaps just possible. Reliably Quiet conditions ought to have re-established by the start of the coming new working week (UTC), whereupon the focus should shift to a minor recurrent centre-disc coronal hole that may feature beyond this four-day forecast period, albeit with little impact.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate in the last 24 hours, and further M-class events are Likely. The current disc is the preserve of at least five Zurich E-groups, and although some of these are mature and/or are showing a decaying trend, at least two (AR3056 and 3058) showed the opposite, with proliferation and growth. All of the current disc are showing as relatively clear dipoles, with none assessed as Mt Wilson Gamma groups at the time of writing, although AR3053 has had a historic candidate for a Delta spot (now no longer visible).

Considering the overall balance of sunspot groups, one of the current large sunspots should leave the Earth-facing side into the new UTC working week, resulting in a slight dip in flare risk on day four, Monday 18 July. Arriving bright flux over the eastern limb may compensate for any loss, however this will be assessed as and when this region arrives over the northeastern solar horizon.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)

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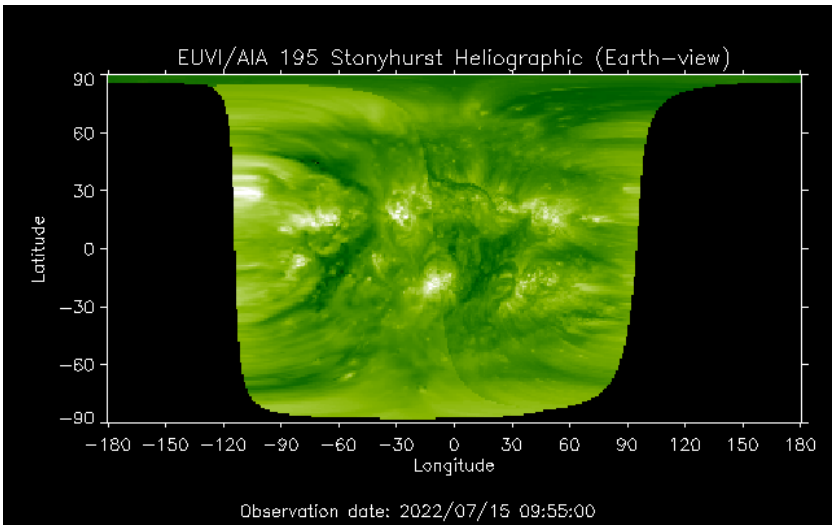
Active	**R1-R2 M Class**	Yes	75	75	75	60
Very Active	**R3 to R5 X Class**	No	10	10	10	10

Figure 3: Locations of X-ray flares in the past 24 hours (left, courtesy of SIDC ROB); as well as latest available HMIIF and HMIBC imagery. Flare activity can be seen to be roughly correspond to growth trends rather than overall Zurich complexity, with the exception of AR3053 in the northwest which is flaring but also visually shrinking.

Figure 4: Cylindrical projection of the sun in 195 Angstroms, showing a possible returning region over th northeastern limb that may yet compensate for the expected loss over the northwestern horizon of AR3053 later in the UTC weekend.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels.

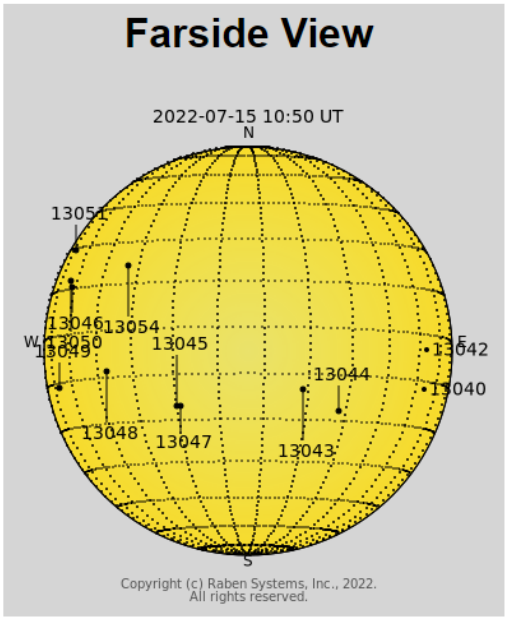
Owing to the complexity of the current disc, and in particular the presence of two Zurich E-groups in the western solar hemisphere, there is considered a daily Slight Chance of an S1 or greater.

Sub-S1 events of the past week were tied to a feature (Ex-3047) that is now long since past its peak geoeffective location (being several days onto the far side), and none of the present front-side sunspots have any history of any proton enhancement given sizeable flares.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 5: Past week in GOES16 high energy protons. The 4pfu response on 09 July and subsequent more minor enhancements are thought to have largely emanated from Ex-3047, which is now comfortably onto the far side (see right image, courtesy Raben Systems Inc).



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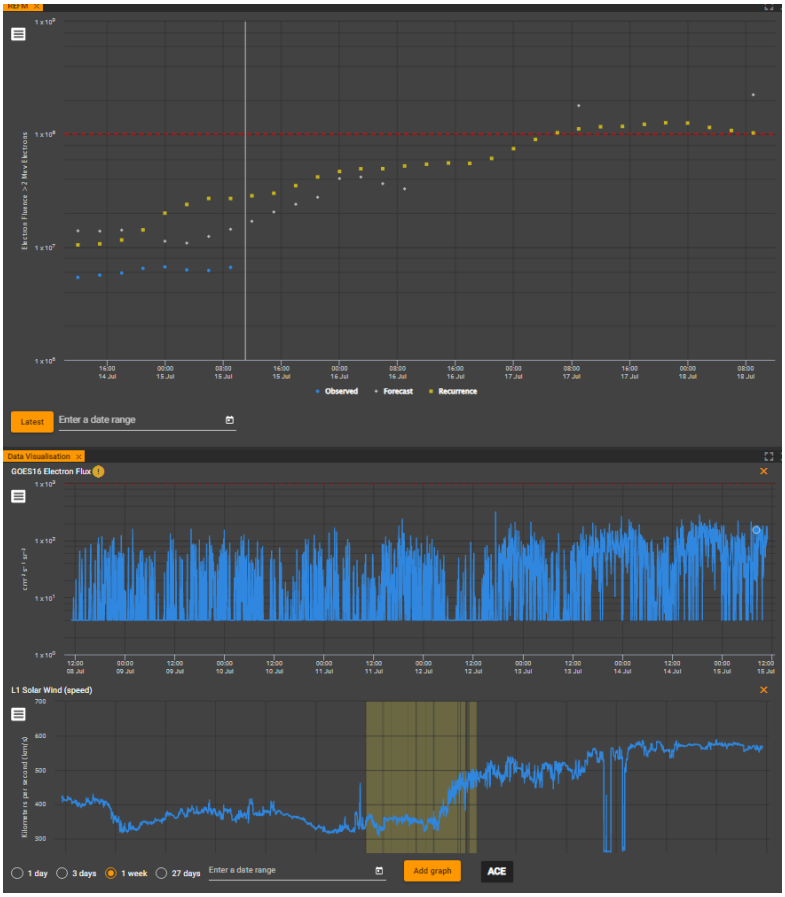
High Energy Electrons Event (≥ 2MeV):

The diurnal variation in high energy electron flux (greater than 2MeV) is currently peaking at Moderate levels. The current elevated solar wind speed ought to manifest over the UTC weekend as a rising flux, with MOSWOC SWPM and 211 imagery between rotations offering a fairly close match, lending confidence to REFM's assertion that Active 24-hour integrated fluence should become increasingly likely, perhaps even Expected by the new week. This does depend on the continued absence of CME activity, which while currently true is far from assured given the numerous large sunspot groups and presence of significant filaments on the current disc.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	40	60	80
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

Figure 6: Latest MOSWOC REFM forecast, 27-day persistence and observed 24-hour integrated fluence. Also shown is past week in GOES16 electron flux and the driving solar wind speed at L1. The predecessor of the current fast wind did prove capable of Active fluence on last rotation, and given the similairities in current observations, similar is expected on this pass.



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